NAME: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Chemistry 313

Chapter 12

**CHEMICAL QUANTITIES**

***Chapter Outline***

12.2 🡪 Using Moles

*Vocabulary*

|  |  |  |
| --- | --- | --- |
| Stoichiometry | Actual yield | Theoretical yield |

*Objectives*

* **Predict** quantities of reactants and products in chemical reactions
* **Determine** mole ratios from balanced chemical equations
* **Calculate** the percent yield of a reaction given an initial quantity of reactant(s) and the actual yield of product.

Warm-up

**Slide 3: What is Stoichiometry**

Stoichiometry is the study of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_relationships between amounts of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ used and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ formed by a chemical reaction.

A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is needed to solve any stoichiometry problem.

**Slide 4: Practical Applications of Stoichiometry**

In a spacecraft, the carbon dioxide exhaled by astronauts can be removed by its reaction with lithium hydroxide, LiOH, according to the following chemical equation.

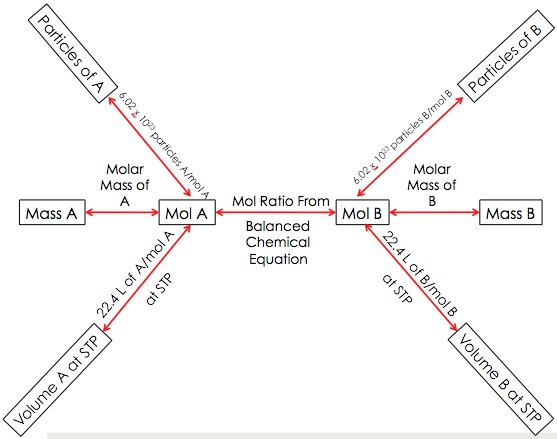
\_\_CO2(g) + \_\_LiOH(s) \_\_ Li2CO3(s) +\_\_ H2O(l)

How many moles of lithium hydroxide are required to react with 20 mol of CO2, the average amount exhaled by a person each day?

Answer: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Slide 5: Strategy – Relate everything to the mole**

The \_\_\_\_\_\_\_\_\_\_ is the common thread that links reactants to products.

[](http://www.google.com/url?sa=i&rct=j&q=stoichiometry+mole+map&source=images&cd=&cad=rja&docid=2XsqxpwvxNCqQM&tbnid=hAJdv9S5r4CjhM:&ved=0CAUQjRw&url=http://moodleshare.org/mod/page/view.php?id=8673&ei=i_iGUYDmDJPH0AGhvYGoBQ&bvm=bv.45960087,d.dmQ&psig=AFQjCNHrP92TGsfdtBNzHo7hFqmIODpCyQ&ust=1367886300184711)**Slide 6: The Mole Super Highway**

**Slide 7: Practice Problems – Mole to Mole**

How many moles of water are formed when 3.8 moles of Hydrogen react with an excess of Oxygen?

How many moles of oxygen are needed to fully combust 1.6 moles of ethane(C2H6)?



Warm-up

**Slide 9: Practice Problems – Mole to Mass**

How many grams of water are formed when 4.5 moles of oxygen react with an excess of hydrogen?

How many moles of oxygen are needed to produce 15.6g of carbon dioxide?



**Slide 10: Practice Problems – Mass to Mass**

How many grams of water are formed when 18.6 grams of oxygen react with an excess of hydrogen?

How many grams of ethane are needed to produce 23.4g of water?

Warm-up

**Slide 12: Practice Problems – Volume at STP**

How many liters of oxygen are required to react with 5.6 liters of hydrogen to produce water at STP?

Warm-up

**Slide 14: Percent Yield**

Stoichiometric calculations provide a theoretical yield or maximum amount of product that can be produced from a given amount of reactants.

The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ yield is the amount that is actually produced when a reaction is carried out.

The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ yield reflects the ratio of the theoretical and actual yields



**Slide 15: Practice Problem - Percent Yield**

When 4.3 grams of sodium are combined with aluminum nitrate in the following equation, 1.52g of aluminum are produced. What is the percent yield of aluminum?

Mole-Mole Stoichiometry ( 1 step)

1. How many moles of hydrogen are required to produce 2.45 mole of ammonia?

**\_\_N2 + \_\_H2 → \_\_NH3**

1. How many moles of potassium chloride are produced when 10.03 mole of potassium chlorate decomposes?

**\_\_KClO3 → \_\_KCl + \_\_ O2**

1. How many moles of zinc are required to react with 47.90 moles of hydrochloric acid?

**\_\_Zn + \_\_HCl → \_\_ ZnCl2**

1. How many moles of water vapor are produced when 66.20 moles of oxygen reacts with hexane?

**\_\_C6H14  + \_\_O2 → \_\_CO2 + \_\_H2O**

1. How many moles of potassium bromide are required to produce 80.035 moles of aluminum bromide?

**\_\_Al(NO3)3 + \_\_ KBr → \_\_AlBr3 + \_\_KNO3**

Mole – Mass Stoichiometry (2 steps)

1. How many grams of ammonia are produced when 7.40 mole of hydrogen react with nitrogen?
2. How many grams of potassium chlorate will decompose to form 25.9 mole of oxygen gas?
3. How many moles of zinc chloride are formed when 3.61 g of hydrochloric acid reacts?
4. How many moles of hexane are needed to produce 45.8 g of carbon dioxide?
5. How many grams of aluminum nitrate are required to produce 11.9 moles of potassium nitrate?

**Masss – Mass Stoichiometry (3 steps)**

* 1. How many grams of ammonia are produced if 9.50 g of nitrogen are available?
  2. How many grams of potassium chlorate are required to produce 20.07 grams of potassium chloride?
  3. How many grams of hydrochloric acid are required to produce 15.5 grams of zinc chloride?
  4. How many grams of water will be produced if 10.0 grams of oxygen are available?
  5. How many grams of aluminum nitrate are needed to produce 40.77 grams of aluminum bromide?

**Stoichiometry Worksheet 4 (Mass-Volume/Volume-Volume at STP**

1. Pentane (C5H12) burns according to the following *unbalanced* reaction: Assume STP

\_\_\_\_C5H12 (g) + \_\_\_\_O2 (g) \_\_\_\_CO2 (g) + \_\_\_\_H2­O(g)

1. What volume of O2 is required to produce 48.0 L of Carbon dioxide?
2. What volume of H2O(g) is produced when 106 L of CO2 is created?
3. What mass of Pentane would be required to produce 80.0 L of CO2?

2. Given the following equation:

3 NO2 (g) + H2O(l) 2 HNO3 (aq) + NO(g) Assume STP

1. If 42.0 L of NO(g) is produced, what volume of NO2 (g) reacted?
2. What volume of Nitrogen monoxide would be produced from 100.0 g of water?

2. The corrosion (rusting) of iron is represented as follows:

3 O2­ (g) + 4 Fe(s) 2 Fe2O3 (s)

1. What volume of Oxygen gas would be required to produce 16.0 g of Fe2O3 at STP?

Theoretical and Percent Yield Worksheet

1. Given the following equation:

\_\_\_\_\_ K2PtCl4  + \_\_\_\_\_ NH3   --------> \_\_\_\_\_ Pt(NH3)2Cl2  + \_\_\_\_\_ KCl

1. Balance the equation.
2. Starting with 34.5 g of NH3, and you isolate 76.4 g of Pt(NH3)2Cl2, what is the percent yield?
3. Given the following equation:

  H3PO4    +     3 KOH    ------>  K3PO4     +  3 H2O

1. If 49.0 g of H3PO4 is reacted with excess KOH, determine the percent yield of K3PO4 if you isolate 49.0 g of K3PO4.
2. Given the following equation:

  Al2(SO3)3    +  6 NaOH  ------> 3 Na2SO3    +   2 Al(OH)3

1. If you start with 389.4 g of Al2(SO3)3 and you isolate 212.4 g of Na2SO3, what is your percent yield for this reaction?
2. Given the following equation:

 Al(OH)3 (s)   +  3 HCl (aq)  ------->   AlCl3 (aq)   +   3 H2O (l)

1. If you start with 50.3 g of Al(OH)3 and you isolate 39.5 g of AlCl3, what is the percent yield?
2. Given the following equation:

 K2CO3    +     HCl   -------->        H2O     +    CO2    +    KCl

1. Balance the equation.
2. Starting with 34.5 g of K2CO3, and you isolate 3.4 g of H2O, what is the percent yield?

Homework #1

1. Identify 6 of the 12 possible mole ratios in the following equation

Al2(SO3)3    +  6 NaOH  ------> 3 Na2SO3    +   2 Al(OH)3

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ d. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ e. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ f. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. How many mole of Na2SO3  are formed when 2.5 moles of NaOH are reacted with Al2(SO3)3   ?
5. How many grams of NaOH are required to produce 1.5 moles of Al(OH)3?
6. What mass of 2 Al(OH)3  is produced from 16.8g ?

Homework #2

1. What volume of chlorine gas is produced at STP when 3.1g of tin IV chloride reacts with fluorine gas in the following equation?

SnCl4 + 2F2 → SnF4 + 2Cl2

1. Balance the following equation

\_\_\_\_\_O2­ (g)  + \_\_\_\_\_\_Fe(s) → \_\_\_\_\_\_Fe2O3 (s)

1. When 2.43g of iron reacts with oxygen, 1.6g of iron III oxide are produced in the lab
   1. What is the actual yield? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   2. Calculate the theoretical
   3. Calculate the percent yield.